Contents lists available at ScienceDirect

Asia-Pacific Journal of Oncology Nursing

Original Article

Knowledge, attitudes, and practices toward nutritional management among patients with gastrointestinal cancer: A cross-sectional study

Xiaoxu Zhi [a,#], Jie Chen [a,#], Liu Yang [b], Sheng Li [a], Liuliu Zhang [a], Yun Zhao [a], Min Wang [a], Zhiyan Zhou [a], Funa Yang [c], Zhie Gu [d], Xiaoju Zhang [e,f], Huizi Tian [g], Qin Xu [h], Jun Yao [i,j,*]

[a] The Affiliated Cancer Hospital of Nanjing Medical University & Jiangsu Cancer Hospital & Jiangsu Institute of Cancer Research, Nanjing, China
[b] Department of Colorectal Surgery, The Affiliated Cancer Hospital of Nanjing Medical University & Jiangsu Cancer Hospital & Jiangsu Institute of Cancer Research, Nanjing, China
[c] Nursing Department, Henan Cancer Hospital & the Affiliated Cancer Hospital of Zhengzhou University, Zhenzhou, China
[d] Education and Training Department, Northern Jiangsu People's Hospital, Yangzhou, China
[e] Department of Nursing, Fudan University Shanghai Cancer Center, Shanghai, China
[f] Department of Oncology, Shanghai Medical College, Fudan University, Shanghai, China
[g] Department of Gastric Oncology, Tianjin Medical University Cancer Hospital & Institute, Tianjin, China
[h] School of Nursing, Nanjing Medical University, Nanjing, China
[i] School of Health Policy and Management, Nanjing Medical University, Nanjing, China
[j] Institute of Healthy Jiangsu Development, Nanjing Medical University, Nanjing, China

ARTICLE INFO

ABSTRACT

Objective: This study aimed to evaluate the knowledge, attitudes, and practices (KAP) regarding nutritional management among patients with gastrointestinal cancer.

Methods: A descriptive cross-sectional study was conducted from December 2023 to May 2024 across hospitals in Jiangsu, Henan, Shanghai, and Tianjin, China. Participants completed questionnaires that collected demographic data and assessed their KAP toward nutritional management.

Results: A total of 1239 valid questionnaires were analyzed. Among the participants, 769 (62.1%) were male, and 452 (36.5%) had been diagnosed with gastrointestinal cancer for less than six months. The proportion of participants demonstrating adequate knowledge, positive attitudes, and proactive practices were 1018 (82.1%), 328 (26.4%), and 403 (32.5%), respectively. Multivariate logistic regression identified several factors independently associated with proactive practices, including adequate knowledge, lack of insurance, a gastrointestinal tumor duration of 2–3 years or more, no doubts about nutritional management, absence of nutritional screening, and having others as primary caregivers. Structural equation modeling revealed direct effects of knowledge on both attitude ($\beta = 0.308$, $P < 0.001$) and practice ($\beta = 0.475$, $P < 0.001$), as well as of attitude on practice ($\beta = 0.286$, $P < 0.001$). Additionally, knowledge indirectly influenced practice through attitude ($\beta = 0.088$, $P < 0.001$).

Conclusions: While most gastrointestinal cancer patients demonstrated adequate knowledge regarding nutritional management, their attitudes were predominantly negative, and their practices were largely inactive. These findings highlight a critical need for targeted educational interventions to bridge knowledge gaps and encourage more active engagement with nutritional guidelines.

Introduction

Nutritional management refers to the comprehensive approach of assessing, planning, and implementing dietary interventions tailored to support patients' health outcomes.[1] Nutrition plays a dual role in the management of gastrointestinal cancers—a collective term referring to malignancies of the colorectum, small intestine, stomach, liver, esophagus, and pancreas—as both a determinant of patient outcomes and a critical support mechanism.[2] These cancers were responsible for approximately 3.5 million deaths globally in 2020, with 5.0 million new cases reported during the same period.[3] Among them, gastric carcinoma (GC) stands as the fourth most prevalent malignancy worldwide and the

second deadliest cancer.[4–6] Similarly, colorectal cancer (CRC) ranks as the fourth leading cause of cancer death, accounting for claiming nearly 900,000 lives annually.[7]

Patients with gastrointestinal cancers often exhibit weight loss and signs of malnutrition at the time of hospital admission, due to impaired nutrient digestion and absorption.[2] Surgical intervention, the primary therapeutic strategy for these cancers, frequently disrupts the gastrointestinal anatomy and physiological function, leading to further nutritional challenges and gastrointestinal symptoms.[8,9] The severity of malnutrition in these patients is strongly associated with poorer prognoses, increased postoperative complications, and higher morbidity and mortality rates, as well as prolonged hospital stays.[10] Thus, meticulous nutritional management is essential for improving prognosis, quality of life, and treatment tolerance in this oncological patient population. In the nursing context, the focus of nutritional management include conducting nutritional screenings, educating patients about balanced diets, and monitoring dietary intake to support recovery. Nurses play a vital role in the nutritional management of patients.[11] For patients with gastrointestinal cancer, nurses' responsibilities extend to managing complex nutritional needs resulting from impaired digestion and absorption, as well as postoperative complications affecting nutritional intake.

The Knowledge, Attitudes, and Practices (KAP) survey serves as an essential diagnostic tool in health literacy research. It examines a group's understanding, beliefs, and behaviors towards specific health-related topics, based on the premise that enhanced knowledge positively influences attitudes, which in turn shape behaviors.[12–16]

There is currently a lack of robust evidence to determine the optimal method for nutritional support before upper gastrointestinal cancer resection.[17] Malnutrition affects approximately 40%–80% of cancer patients,[18] and two-thirds of them consume less than 25 kcal per kilogram of body weight per day. This caloric intake is insufficient to meet even their basic metabolic needs, let alone the increased demands of anabolic processes associated with recovery.[19] In the context of gastrointestinal cancer, assessing patients' knowledge about nutritional management, their attitudes towards it, and their actual practices is pivotal for enhancing nutritional interventions and improving treatment outcomes.

Despite the well-recognized importance of nutritional management in treating gastrointestinal cancer, numerous challenges remain in clinical practice. Many patients have not received professional dietary advice and express a keen interest in learning more about nutrition. They often feel uncertain about how to implement nutritional recommendations and would appreciate guidance from healthcare professionals.[20] Consequently, there is a compelling need to delve deeply into the knowledge, attitudes, and practices of these patients concerning nutritional management to tailor and enhance intervention programs.

Currently, systematic research on the KAP concerning nutritional management in gastrointestinal cancer patients is lacking. Filling this gap is crucial for developing effective and personalized nutritional strategies. Thus, this study aims to evaluate the KAP toward nutritional management among patients with gastrointestinal cancer.

Methods

Study design and participants

This cross-sectional study was conducted from December 2023 to May 2024 across hospitals in Jiangsu, Henan, Shanghai, and Tianjin. Participants included patients diagnosed with gastrointestinal cancer. This study was approved by the Ethic Committee of Jiangsu Cancer Hospital (Approval No. 2022KE-KUAI058), and all participants provided written informed consent. The research team in the leading hospital was comprised of department heads, head nurses, charge nurses, graduate students, surveyors, and statisticians. The lead institution coordinated the research efforts, while partner institutions assigned head nurses and surveyors, who underwent standardized training and assessment by the

project leader before initiating data collection. The graduate students and statisticians cross-checked the data weekly for completeness, and the researchers maintained close communication with the head nurses to address any challenges during data collection. Regular discussions were held with department heads to assess patients' nutritional status. For patients with moderate to severe malnutrition, emergency protocols were activated, where charge nurses conducted comprehensive evaluations, identified influencing factors, and communicated findings to department heads, who referred patients to the appropriate medical teams for treatment.

Inclusion criteria: (1) Pathologically confirmed diagnosis of gastrointestinal cancer (Oesophageal tumor, Gastric tumor, Hepatic tumor, Pancreatic tumor, Colon tumor, Rectal tumor, etc.); (2) Individuals aged 18 years or older; (3) Patients who have undergone treatment modalities such as surgery, pharmacotherapy, or radiotherapy; (4) Provision of informed consent by patients and their families. Exclusion criteria: (1) Cognitive impairments that hinder communication; (2) Presence of severe organic diseases, such as cardiovascular disease, liver, or renal failure, that would preclude participation in the study.

Questionnaire introduction

The questionnaire design was informed by several authoritative sources including the "*Chinese Guidelines for Nutritional Therapy in Patients with Malignant Tumors (2022)," and the "Expert Consensus on Nutritional Management During the Rehabilitation Period of Cancer Patients (2022 Edition)*." Additional guidelines from international bodies such as ASPEN (www.nutritioncare.org) and ESPEN (www.espen.org) were also referenced. Initial drafts underwent revisions based on feedback from a panel of 12 experts in oncology, nursing, nutrition, and nursing education. This process led to a refinement of the questionnaire's content, thereby enhancing its content validity. A pilot study involving 54 participants was conducted to test the questionnaire, resulting in a high overall Cronbach's α coefficient of 0.891, demonstrating strong internal consistency. During the pilot study, participants were encouraged to ask questions about any items they found confusing or unclear, and researchers provided explanations as needed. After these clarifications, no items were reported as confusing, confirming the face validity of the study.

The results of confirmatory factor analysis demonstrated good model fit, with the following indices: root mean square error of approximation (RMSEA) = 0.089, standardized root mean square residual (SRMR) = 0.162, Tucker–Lewis index (TLI) = 0.758, and comparative fit index (CFI) = 0.774, further supporting the validity of the questionnaire (Supplementary Fig. S1).

In the knowledge dimension, six items were removed based on the expert panel's suggestions to ensure clarity and relevance. These included statements about dietary nutrition white papers, protein intake, weight management during recovery, the importance of exercise in maintaining muscle function, diet and exercise during the rehabilitation period, and standard BMI ranges for adults in China. In the practice dimension, items regarding conflicting information about diet and nutrition were removed to streamline the focus. New items were added to enhance the assessment of adherence to professional nutritional management advice and awareness of nutrition-related symptoms.

The final questionnaire, presented in Chinese, includes four sections: demographic information, knowledge, attitudes, and practices (**Supplementary file 1**). The knowledge section consists of 14 questions with a scoring range from 0 (not understood) to 2 (well-understood), totaling up to 28 points. The attitude section employs a five-point Likert scale from very positive (5 points) to very negative (1 point), encompassing 8 questions with scores ranging from 8 to 40 points. The practice section included 9 questions, scored from strongly agree (5 points) to strongly disagree (1 point), with total possible scores between 9 and 45 points. A score of 70% or higher of the maximum possible score was defined as indicative of good knowledge, positive attitude, and proactive practice.[21]

Questionnaire distribution and quality control

The study employed a convenience sampling method to select patients with gastrointestinal tumors and was conducted via the Questionnaire Star platform (https://www.wjx.cn/), involving patients from 10 tertiary hospitals across Shanghai, Henan, Jiangsu, and Anhui provinces, including five top-tier oncology specialty hospitals and five general hospitals with oncology departments. The principal investigator coordinated with hospital heads and administrators to ensure understanding of the study's objectives and protocol, and uniform training was provided for research assistants survey administrators. All research assistants underwent standardized online training to ensure they understood the study objectives and protocols, and to address any questions they had. Research assistants explained the purpose of the survey and the content of the questionnaire to participants. After ensuring participants fully understood the information, research assistants distributed a two-dimensional code to access the electronic questionnaire. Participants scanned the a two-dimensional code using WeChat to complete the survey. Designated liaison officers were appointed to monitor the quality of data collection. Each IP address was allowed only one submission, and all questions were mandatory. The project team conducted thorough checks on the completed questionnaires to identify and discard any that exhibited logical inconsistencies, unusually quick completion times, or patterns indicative of non-genuine responses. Research assistants were available to clarify and resolve any issues participants encountered while answering the questions.

Sample size calculation

To determine the required sample size for a cross-sectional study, the following formula of cross-sectional study is used:[22] $n = [Z^2 \times P \times (1 - P)] / E^2$, Where n is the required sample size, Z is the Z-value corresponding to the desired confidence level (for a 95% confidence level, $Z = 1.96$), P is the estimated proportion of the population (commonly assumed to be 0.5 when unknown), E is the margin of error (typically set at 0.05). For a 95% confidence level, with $P = 0.5$ and $E = 0.05$, the formula calculates as: $n = [1.96^2 \times 0.5 \times (1–0.5)] / 0.05^2 = 384.16$. The minimal sample size was 480 which includes an extra 20% to allow for subjects lost.

Statistical analysis

Statistical analysis was conducted using R 4.3.2 and Stata 18.0 (Stata Corporation, College Station, TX, USA). The reliability of the KAP scale was evaluated using Cronbach's alpha coefficient. In addition, the content validity and face validity were assessed, while confirmatory factor analysis was used to examine construct validity. Continuous variables were described using median (25th percentile, 75th percentile), and between-group comparisons were performed using Wilcoxon–Mann–Whitney tests or Kruskal–Wallis analysis of variance. Categorical variables were presented as n (%). Univariate and multivariate logistic regression were performed to explore the risk factors associated with good knowledge, positive attitudes, and positive practices. Univariate variables with $P < 0.1$ were enrolled in multivariate regression. Based on the KAP theoretical framework, a structural equation model (SEM) was applied to examine whether attitudes mediate the relationship between knowledge and practice, and to calculate and compare the indirect and direct effects. Model fit was evaluated using RMSEA, incremental fit index (IFI), TLI, and CFI. Two-sided $P < 0.05$ were considered statistically significant in this study.

Results

The initial sample comprised 1373 participants. Exclusions were made as follows: (1) four cases were excluded due to lack of informed consent; (2) 77 cases were excluded for response times under 120 seconds; (3) 43 cases were excluded where all responses in the knowledge section were marked as "don't know"; and (4) 10 cases were excluded due to anomalous entries in the age field. Consequently, the final dataset consisted of 1239 valid cases. Demographically, out of 1239 participants, 641 (51.7%) were aged 35–64 years, 769 (62.1%) were male, 524 (42.3%) reported a monthly per capita household income between 2001 and 5000 Yuan, and 452 (36.5%) had been diagnosed with a gastrointestinal tumor for less than six months. Additionally, 572 (46.2%) expressed concerns about nutritional management, and 756 (61.0%) were primarily cared for by their spouse. The median scores for knowledge, attitudes, and practices were 13.00 [9.00, 17.00], 31.00 [27.00, 34.00], and 34.00 [30.00, 38.00], respectively (Table 1).

Key knowledge gaps included familiarity with the "Dietary Guidelines for Chinese Residents (2022)" (73.9% unfamiliar), the relationship between nutritional status and tumor treatment tolerance (37.4% unfamiliar), and the need for regular nutritional screening (29.2% unfamiliar). Notably, 32.4% believed that the absence of weight loss implied no malnutrition, and 15% thought skipping meals could starve tumor cells. In practice, 15.4% did not undergo regular nutritional screening, and 11.9% did not consult official guidelines on nutritional management. For further details, refer to Supplementary Tables S1–3.

The top 70% of scores across knowledge, attitude, and practice dimensions were used to establish cut-off values, below which were 1018 (82.2%), 328 (26.5%), and 403 (32.5%) participants, respectively (Table 2).

Multivariate logistic regression showed that high school/technical secondary school education (OR = 1.935, 95% CI: [1.164, 3.218], $P = 0.011$), junior college education or above (OR = 2.258, 95% CI: [1.319, 3.864], $P = 0.003$), with monthly per capita household income of more than 2000 Yuan (OR > 1, $P < 0.05$), have some doubts about nutritional management (OR = 2.237, 95% CI: [1.103, 4.538], $P = 0.026$), no doubts about nutritional management (OR = 5.379, 95% CI: [2.694, 10.741], $P < 0.001$), without nutritional screening (OR = 3.872, 95% CI: [2.790, 5.372], $P < 0.001$), with children as primary caregiver (OR = 1.748, 95% CI: [1.194, 2.561], $P = 0.004$), and no use of nutrition tube (OR = 0.355, 95% CI: [0.138, 0.912], $P = 0.031$) were independently associated with knowledge (Table 3).

Knowledge (OR = 1.035, 95% CI: [1.012, 1.058], $P = 0.003$), married (OR = 2.404, 95% CI: [1.184, 4.882], $P = 0.015$), divorced/widowed (OR = 4.314, 95% CI: [1.551, 11.998], $P = 0.005$), living in urban (OR = 1.483, 95% CI: [1.065, 2.067], $P = 0.020$), with monthly per capita household income of 5001–10000 Yuan (OR = 0.625, 95% CI: [0.402, 0.970], $P = 0.036$), with monthly per capita household income of more than 20000 Yuan (OR = 0.517, 95% CI: [0.273, 0.978], $P = 0.042$), have commercial health insurance (OR = 0.059, 95% CI: [0.011, 0.302], $P = 0.001$), no insurance (OR = 0.154, 95% CI: [0.083, 0.285], $P < 0.001$), have rectal tumor (OR = 1.552, 95% CI: [1.005, 2.396], $P = 0.047$), with family history of tumors (OR = 1.638, 95% CI: [1.117, 2.402], $P = 0.012$), have some doubts about nutritional management (OR = 1.833, 95% CI: [1.251, 2.685], $P = 0.002$), and no doubts about nutritional management (OR = 2.353, 95% CI: [1.559, 3.551], $P < 0.001$) were independently associated with attitude (Table 4).

Knowledge (OR = 1.089, 95% CI: [1.063, 1.116], $P < 0.001$), no insurance (OR = 2.556, 95% CI: [1.244, 5.255], $P = 0.011$), 2–3 years of gastrointestinal tumor duration (OR = 0.529, 95% CI: [0.332, 0.844], $P = 0.008$), 3 years of gastrointestinal tumor duration or more (OR = 0.626, 95% CI: [0.408, 0.961], $P = 0.032$), no doubts about nutritional management (OR = 1.539, 95% CI: [1.015, 2.334], $P = 0.042$), without nutritional screening (OR = 4.288, 95% CI: [2.921, 6.295], $P < 0.001$), and with others as primary caregiver (OR = 0.492, 95% CI: [0.291, 0.832], $P = 0.008$) were independently associated with practice (Table 5).

The SEM analysis revealed significant direct effects of knowledge on both attitude ($\beta = 0.304$, $P < 0.001$) and practice ($\beta = 0.287$, $P < 0.001$), as well as a significant direct effect of attitude on practice ($\beta = 0.247$, $P < 0.001$). Knowledge also indirectly influenced practice through attitude

Table 1
Baseline characteristics and KAP scores.

Characteristics	n (%)	Knowledge, Median [25%, 75%]	P	Attitude, Median [25%, 75%]	P	Practice, Median [25%, 75%]	P
	1239 (100.0)	13.00 [9.00, 17.00]		31.00 [27.00, 34.00]		34.00 [30.00, 38.00]	
Age, years			0.080		0.318		0.099
< 35	61 (4.9)	14.00 [12.00, 19.00]		31.00 [24.00, 34.00]		35.00 [31.00, 37.00]	
35–64	641 (51.7)	13.00 [9.00, 16.00]		31.00 [27.00, 34.00]		35.00 [30.00, 38.00]	
65–79	480 (38.7)	13.00 [9.00, 17.00]		32.00 [27.00, 34.00]		34.00 [29.00, 38.00]	
≥ 80	57 (4.6)	13.00 [9.00, 15.00]		30.00 [25.00, 33.00]		33.00 [28.00, 36.00]	
Sex			0.515		0.722		0.398
Male	769 (62.1)	13.00 [9.00, 16.00]		31.00 [27.00, 34.00]		34.00 [30.00, 38.00]	
Female	470 (37.9)	13.00 [9.00, 17.00]		31.00 [27.00, 34.00]		35.00 [30.00, 39.00]	
Marital status			0.136		0.402		0.707
Single	43 (3.5)	14.00 [12.50, 18.00]		30.00 [24.00, 34.00]		36.00 [31.00, 40.50]	
Married	1135 (91.6)	13.00 [9.00, 16.50]		31.00 [27.00, 34.00]		34.00 [30.00, 38.00]	
Divorced/Widowed	61 (4.9)	13.00 [9.00, 17.00]		32.00 [29.00, 34.00]		34.00 [29.00, 37.00]	
Residence			0.001		0.004		0.250
Rural	591 (47.7)	12.00 [8.00, 15.00]		31.00 [26.00, 34.00]		34.00 [29.00, 38.00]	
Urban	532 (42.9)	13.00 [10.00, 17.00]		32.00 [28.00, 34.00]		35.00 [31.00, 38.00]	
Suburban	116 (9.4)	14.00 [9.00, 20.00]		32.00 [29.00, 34.00]		34.00 [28.00, 39.25]	
Education			< 0.001		< 0.001		0.009
Primary school or below	354 (28.6)	12.00 [7.00, 15.00]		31.00 [27.00, 34.00]		33.00 [28.00, 37.00]	
Middle school	394 (31.8)	13.00 [9.00, 16.00]		30.00 [26.00, 34.00]		34.00 [30.00, 38.00]	
High school/Technical secondary school	262 (21.1)	13.00 [9.00, 18.00]		32.00 [28.00, 34.00]		34.00 [31.00, 38.00]	
Junior college or above	229 (18.5)	14.00 [11.00, 20.00]		32.00 [29.00, 35.00]		36.00 [31.00, 39.00]	
Family members with healthcare professionals			0.117		0.723		0.001
Yes	162 (13.1)	13.00 [10.00, 17.00]		31.00 [26.00, 34.00]		36.00 [32.00, 41.00]	
No	1077 (86.9)	13.00 [9.00, 17.00]		31.00 [27.00, 34.00]		34.00 [30.00, 38.00]	
Monthly per capita household income, yuan			< 0.001		0.421		0.117
≤ 2000	260 (21.0)	12.00 [7.00, 14.00]		31.00 [28.00, 34.00]		34.00 [29.00, 38.00]	
2001–5000	524 (42.3)	13.00 [9.00, 17.00]		32.00 [27.00, 34.00]		34.00 [29.00, 37.00]	
5001–10,000	308 (24.9)	13.00 [11.00, 18.00]		31.00 [25.00, 34.00]		35.00 [31.00, 38.25]	
10,001–20,000	76 (6.1)	13.00 [10.00, 16.50]		32.00 [29.00, 34.00]		35.00 [30.00, 39.00]	
> 20,000	71 (5.7)	15.00 [11.00, 24.00]		31.00 [27.00, 34.00]		35.00 [30.00, 39.00]	
Type of health insurance			< 0.001		< 0.001		0.003
Social health insurance only	1120 (90.4)	13.00 [9.00, 16.00]		31.00 [28.00, 34.00]		34.00 [30.00, 38.00]	
Commercial health insurance	9 (0.7)	14.00 [12.00, 14.00]		24.00 [24.00, 25.00]		36.00 [27.00, 36.00]	
Both social and commercial health insurance	55 (4.4)	17.00 [12.00, 25.00]		33.00 [28.00, 35.00]		37.00 [32.50, 43.00]	
No insurance	55 (4.4)	13.00 [10.50, 13.50]		24.00 [24.00, 30.00]		36.00 [33.00, 36.00]	
Duration since gastrointestinal tumor diagnosis			0.002		0.804		0.053
< 6 months	452 (36.5)	12.00 [8.00, 15.25]		31.00 [27.00, 34.00]		34.00 [30.00, 38.25]	
6–12 months	292 (23.6)	13.00 [9.00, 17.00]		32.00 [27.00, 34.00]		35.00 [31.00, 39.00]	
1–2 years	220 (17.8)	13.00 [10.00, 17.00]		31.00 [27.00, 34.00]		34.50 [30.00, 39.00]	
2–3 years	120 (9.7)	13.00 [10.00, 16.50]		31.00 [26.00, 34.00]		33.00 [28.00, 37.00]	
≥ 3 years	155 (12.5)	13.00 [10.50, 17.50]		31.00 [28.00, 34.00]		34.00 [28.00, 37.00]	
Type of gastrointestinal tumor diagnosed			0.405		0.175		0.558
Oesophageal tumor	200 (16.1)	13.00 [9.00, 17.00]		30.00 [26.00, 33.00]		35.50 [29.00, 38.00]	
Gastric tumor	293 (23.6)	13.00 [10.00, 17.00]		31.00 [27.00, 34.00]		35.00 [31.00, 39.00]	
Hepatic tumor	65 (5.2)	13.00 [5.00, 16.00]		30.00 [27.00, 34.00]		33.00 [29.00, 41.00]	
Pancreatic tumor	64 (5.2)	13.00 [8.75, 15.00]		31.50 [26.75, 34.00]		33.00 [27.75, 39.00]	
Colon tumor	239 (19.3)	13.00 [9.00, 16.00]		32.00 [27.00, 34.00]		35.00 [31.00, 37.00]	
Rectal tumor	305 (24.6)	13.00 [8.00, 17.00]		32.00 [28.00, 34.00]		34.00 [29.00, 38.00]	
Other	73 (5.9)	13.00 [10.00, 16.00]		31.00 [28.00, 34.00]		35.00 [30.00, 39.00]	
Family history of tumors			0.945		0.121		0.408
Yes	234 (18.9)	13.00 [9.00, 15.00]		32.00 [29.00, 34.00]		34.00 [29.00, 38.00]	
No	1005 (81.1)	13.00 [9.00, 17.00]		31.00 [27.00, 34.00]		34.00 [30.00, 38.00]	
Doubts about nutritional management			< 0.001		< 0.001		< 0.001
Yes, many doubts	170 (13.7)	11.00 [7.00, 13.00]		30.00 [25.00, 32.00]		33.00 [27.00, 36.00]	
Yes, some doubts	572 (46.2)	13.00 [9.00, 15.00]		31.00 [27.00, 34.00]		33.50 [29.00, 36.00]	
No doubts	497 (40.1)	14.00 [10.00, 21.00]		32.00 [29.00, 35.00]		36.00 [32.00, 41.00]	
Nutritional screening			< 0.001		0.302		< 0.001
Yes	343 (27.7)	14.00 [11.50, 24.00]		32.00 [27.00, 35.00]		39.00 [35.00, 45.00]	
No	896 (72.3)	12.00 [8.00, 15.00]		31.00 [27.00, 34.00]		33.00 [28.00, 36.00]	
Primary caregiver			0.611		0.272		0.010
Spouse	756 (61.0)	13.00 [9.00, 16.00]		31.00 [27.00, 34.00]		34.00 [30.00, 38.00]	
Parents	83 (6.7)	14.00 [9.00, 19.00]		32.00 [28.00, 34.00]		36.00 [32.00, 40.50]	
Children	322 (26.0)	13.00 [9.00, 18.00]		31.00 [27.00, 34.00]		35.00 [29.00, 39.00]	
Other	78 (6.3)	13.00 [9.00, 15.00]		30.00 [25.00, 33.00]		33.00 [27.00, 36.00]	
Stoma			0.706		0.983		0.877
Yes	225 (18.2)	13.00 [9.00, 17.00]		32.00 [27.00, 34.00]		34.00 [29.00, 39.00]	
No	1014 (81.8)	13.00 [9.00, 16.00]		31.00 [27.00, 34.00]		34.50 [30.00, 38.00]	

(continued on next page)

Table 1 (*continued*)

Characteristics	*n* (%)	Knowledge, Median [25%, 75%]	*P*	Attitude, Median [25%, 75%]	*P*	Practice, Median [25%, 75%]	*P*
Currently using a nutrition tube			0.186		0.078		0.145
Yes	68 (5.5)	12.00 [7.75, 15.00]		30.00 [25.75, 34.00]		36.00 [31.00, 39.00]	
No	1171 (94.5)	13.00 [9.00, 17.00]		31.00 [27.00, 34.00]		34.00 [30.00, 38.00]	

P-values represent the significance of differences in KAP scores across demographic variables. A *P*-value < 0.05 indicates statistical significance.

KAP, Knowledge, Attitude, and Practice; Asum, Sum of attitudes; Psum, Sum of practices; SEM, Structural Equation Modeling.

Table 2
KAP cut-off values and distribution.

KAP cut-off values	*n* (%)
Knowledge	
Ksum ≥ 20	221 (17.8)
Ksum ≤ 19	1018 (82.2)
Attitude	
Asum ≥ 28	911 (73.5)
Asum ≤ 27	328 (26.5)
Practice	
Psum ≥ 32	836 (67.5)
Psum ≤ 31	403 (32.5)

KAP, Knowledge, Attitude, and Practice.

(indirect effect: $\beta = 0.075$, $P < 0.001$). Several additional factors were found to influence these variables. Education positively impacted knowledge ($\beta = 0.107$, $P < 0.001$) and indirectly affected both attitude and practice. Monthly per capita household income was positively associated with knowledge ($\beta = 0.146$, $P < 0.001$), attitude ($\beta = 0.044$, $P < 0.001$), and practice ($\beta = 0.053$, $P < 0.001$). Doubts about nutritional management positively influenced both knowledge ($\beta = 0.220$, $P <$

0.001) and practice, directly and indirectly through attitude. In contrast, nutritional screening showed a significant negative association with knowledge ($\beta = -0.245$, $P < 0.001$) and a strong negative effect on practice (Supplementary Table S4 and Fig. 1). The model fit indices suggest that the SEM model provides a good fit for the observed data (Supplementary Table S5).

Discussion

The study demonstrates that patients with gastrointestinal cancer generally exhibit inadequate knowledge but maintain positive attitudes towards nutritional management, though their practices remain suboptimal. It is imperative that clinical programs not only strengthen educational interventions to improve knowledge but also implement supportive strategies that actively encourage effective nutritional practices among these patients.

A key finding from both multivariate logistic regression and is the prominent influence of knowledge in influencing both attitudes and practices, a relationship supported by previous literature indicating that higher knowledge levels about disease and treatment can lead to more

Table 3
Analysis of factors influencing good knowledge.

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Age, years				
< 35				
35–64	0.696 (0.379, 1.351)	0.259		
65–79	0.764 (0.413, 1.496)	0.410		
≥ 80	0.548 (0.202, 1.401)	0.218		
Sex				
Male				
Female	1.076 (0.797, 1.448)	0.628		
Marital status				
Single				
Married	0.823 (0.405, 1.850)	0.611		
Divorced/Widowed	0.654 (0.233, 1.834)	0.414		
Residence				
Rural				
Urban	1.481 (1.084, 2.029)	0.014	0.989 (0.673, 1.455)	0.956
Suburban	2.077 (1.278, 3.313)	0.003	1.642 (0.956, 2.822)	0.073
Education				
Primary school or below				
Middle school	1.366 (0.906, 2.077)	0.139	1.365 (0.855, 2.179)	0.192
High school/Technical secondary school	1.872 (1.215, 2.899)	0.005	1.935 (1.164,3.218)	0.011
Junior college or above	2.390 (1.552, 3.704)	< 0.001	2.258 (1.319, 3.864)	0.003
Family members with healthcare professionals				
Yes				
No	1.054 (0.678, 1.594)	0.808		
Monthly per capita household income, yuan				
≤ 2000				
2001–5000	1.582 (1.014, 2.534)	0.049	1.771 (1.070, 2.933)	0.026
5001–10,000	2.260 (1.416, 3.690)	0.001	2.268 (1.302, 3.948)	0.004
10,001–20,000	2.387 (1.208, 4.619)	0.011	2.133 (1.003, 4.533)	0.049
> 20,000	4.787 (2.569, 8.952)	< 0.001	4.572 (2.279, 9.168)	< 0.001
Type of health insurance				
Social health insurance only				
Commercial health insurance	0.604 (0.033, 3.320)	0.636	0.486 (0.050, 4.727)	0.534
Both social and commercial health insurance	3.222 (1.816, 5.616)	< 0.001	1.576 (0.834, 2.978)	0.161

Table 3 (*continued*)

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	*P*	OR (95% CI)	*P*
No insurance	0.592 (0.225, 1.297)	0.233	0.741 (0.289, 1.898)	0.532
Duration since gastrointestinal tumor diagnosis				
< 6 months				
6–12 months	1.219 (0.831, 1.782)	0.308		
1–2 years	1.050 (0.679, 1.602)	0.825		
2–3 years	1.192 (0.698, 1.975)	0.506		
≥ 3 years	1.108 (0.678, 1.771)	0.674		
Type of gastrointestinal tumor diagnosed				
Oesophageal tumor				
Gastric tumor	1.189 (0.752, 1.903)	0.465		
Hepatic tumor	1.179 (0.564, 2.350)	0.650		
Pancreatic tumor	0.771 (0.331, 1.645)	0.522		
Colon tumor	0.891 (0.539, 1.478)	0.654		
Rectal tumor	0.992 (0.622, 1.596)	0.972		
Other	1.119 (0.548, 2.187)	0.749		
Family history of tumors				
Yes				
No	0.744 (0.493, 1.093)	0.143		
Doubts about nutritional management				
Yes, many doubts				
Yes, some doubts	2.268 (1.195, 4.774)	0.019	2.237 (1.103, 4.538)	0.026
No doubts	6.275 (3.376, 13.025)	< 0.001	5.379 (2.694, 10.741)	< 0.001
Nutritional screening				
Yes				
No	4.339 (3.205, 5.888)	< 0.001	3.872 (2.790, 5.372)	< 0.001
Primary caregiver				
Spouse				
Parents	1.439 (0.804, 2.464)	0.200	1.452 (0.782, 2.698)	0.238
Children	1.497 (1.077, 2.069)	0.015	1.748 (1.194, 2.561)	0.004
Other	0.678 (0.308, 1.327)	0.291	0.667 (0.307, 1.450)	0.307
Stoma				
Yes				
No	0.888 (0.596, 1.294)	0.547		
Currently using a nutrition tube				
Yes				
No	0.430 (0.165, 0.930)	0.052	0.355 (0.138, 0.912)	0.031
Hypertension				
No				
Yes	0.982 (0.715, 1.360)	0.911		
Diabetes				
No				
Yes	1.109 (0.737, 1.718)	0.631		

P-values represent the statistical significance of each variable's influence on knowledge in the univariate and multivariate analyses. $P < 0.05$ indicates statistical significance.

OR, Odds Ratio; CI, Confidence Interval; KAP, Knowledge, Attitude, and Practice; SEM, Structural Equation Modeling.

positive attitudes and improved health practices among patients.[23,24] The SEM results underscore that knowledge directly enhances practices and attitudes, while also exerting a significant indirect effect on practices via attitudes. While the findings indicate a strong influence of knowledge on both attitudes and practices, the observed weaker association between attitude and practice may be due to additional unmeasured factors that influence behavior beyond attitudes alone. This discrepancy suggests that although patients may recognize the importance of nutritional management (reflected in positive attitudes), actual behavior change may require external support mechanisms, such as consistent guidance from healthcare professionals and reinforced behavioral interventions. Future studies utilizing longitudinal designs could provide a clearer understanding of these causal pathways, particularly how shifts in knowledge and attitudes may or may not directly translate into sustained practical engagement with nutritional management.

Residence emerged as a significant variable, with urban residents demonstrating better knowledge and more positive attitudes compared to rural and suburban counterparts. This aligns with previous findings, which reported that urban patients often have better access to healthcare resources, which could explain the higher knowledge and better attitudes observed.[25,26] The significance of residence was evident in both the analysis of differences across KAP dimensions and the regression models,

indicating a persistent urban-rural divide in health education outcomes.

The SEM analysis confirmed education's role in improving knowledge ($\beta = 0.107$, $P < 0.001$) and indirectly strengthening attitudes and practices. Similarly, higher monthly income and health insurance access were found to significantly boost knowledge and, in turn, positively influence attitudes and practices.[27,28] This reinforces the view that education and socioeconomic status enable individuals to better understand and utilize health information, enhancing engagement with nutritional management guidelines. However, the impact on practices remains partially dependent on guidance from healthcare professionals.

Income levels and health insurance status also played notable roles. Patients with higher incomes or health insurance coverage demonstrated better knowledge and attitudes. This could be due to the greater accessibility to healthcare services and resources, including nutritional counseling, which often comes with better financial stability or coverage.[24,29] The significant relationship between these socioeconomic factors and KAP highlights the potential barriers faced by lower-income and uninsured patients in accessing effective nutritional management. Furthermore, SEM results show that nutritional screening had a direct negative effect on knowledge and a substantial indirect negative effect on practices. Additionally, doubts about nutritional management negatively impacted both attitudes and practices, highlighting the importance of

Table 4
Analysis of factors influencing positive attitude.

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P	OR (95% CI)	P
Knowledge	1.042 (1.021, 1.062)	0.003	1.035 (1.012, 1.058)	0.003
Age, years				
< 35				
35–64	1.179 (0.647, 2.068)	0.577		
65–79	1.215 (0.661, 2.154)	0.516		
≥ 80	0.837 (0.382, 1.827)	0.655		
Sex				
Male				
Female	0.923 (0.713, 1.197)	0.544		
Marital status				
Single				
Married	1.812 (0.953, 3.359)	0.063	2.404 (1.184, 4.882)	0.015
Divorced/Widowed	3.335 (1.360, 8.559)	0.010	4.314 (1.551, 11.998)	0.005
Residence				
Rural				
Urban	1.453 (1.114, 1.899)	0.006	1.483 (1.065, 2.067)	0.020
Suburban	1.785 (1.113, 2.970)	0.020	1.465 (0.868, 2.473)	0.152
Education				
Primary school or below				
Middle school	0.935 (0.682, 1.281)	0.678	0.889 (0.630, 1.255)	0.504
High school/Technical secondary school	1.393 (0.965, 2.024)	0.079	1.239 (0.809, 1.898)	0.325
Junior college or above	1.526 (1.035, 2.274)	0.035	1.387 (0.854, 2.254)	0.187
Family members with healthcare professionals				
Yes				
No	0.895 (0.623, 1.302)	0.552		
Monthly per capita household income, yuan				
≤ 2000				
2001–5000	0.911 (0.642, 1.284)	0.599	0.844 (0.579, 1.231)	0.379
5001–10,000	0.692 (0.475, 1.002)	0.053	0.625 (0.402, 0.970)	0.036
10,001–20,000	1.174 (0.643, 2.241)	0.612	0.816 (0.410, 1.623)	0.561
> 20,000	0.799 (0.447, 1.465)	0.455	0.517 (0.273, 0.978)	0.042
Type of health insurance				
Social health insurance only				
Commercial health insurance	0.092 (0.014, 0.384)	0.003	0.059 (0.011, 0.302)	0.001
Both social and commercial health insurance	1.289 (0.681, 2.658)	0.460	0.890 (0.437, 1.815)	0.749
No insurance	0.157 (0.086, 0.276)	< 0.001	0.154 (0.083, 0.285)	< 0.001
Duration since gastrointestinal tumor diagnosis				
< 6 months				
6–12 months	0.958 (0.687, 1.341)	0.802		
1–2 years	0.890 (0.622, 1.282)	0.528		
2–3 years	0.883 (0.568, 1.398)	0.589		
≥ 3 years	1.114 (0.733, 1.720)	0.619		
Type of gastrointestinal tumor diagnosed				
Oesophageal tumor				
Gastric tumor	1.406 (0.948, 2.085)	0.090	1.425 (0.929, 2.185)	0.105
Hepatic tumor	1.193 (0.655, 2.233)	0.572	1.454 (0.756, 2.796)	0.262
Pancreatic tumor	1.362 (0.737, 2.606)	0.335	1.332 (0.688, 2.581)	0.396
Colon tumor	1.406 (0.931, 2.128)	0.106	1.239 (0.789, 1.945)	0.352
Rectal tumor	1.623 (1.091, 2.415)	0.017	1.552 (1.005, 2.396)	0.047
Other	1.623 (0.889, 3.077)	0.125	1.638 (0.846, 3.169)	0.143
Family history of tumors				
Yes				
No	1.758 (1.240, 2.542)	0.002	1.638 (1.117, 2.402)	0.012
Doubts about nutritional management				
Yes, many doubts				
Yes, some doubts	1.744 (1.219, 2.488)	0.002	1.833 (1.251, 2.685)	0.002
No doubts	2.782 (1.906, 4.058)	< 0.001	2.353 (1.559, 3.551)	< 0.001
Nutritional screening				
Yes				
No	0.996 (0.753, 1.324)	0.977		
Primary caregiver				
Spouse				
Parents	1.195 (0.712, 2.096)	0.515		
Children	1.005 (0.749, 1.357)	0.972		
Other	0.670 (0.412, 1.111)	0.112		
Stoma				
Yes				
No	1.016 (0.735, 1.419)	0.925		
Currently using a nutrition tube				
Yes				
No	0.643 (0.388, 1.090)	0.092	1.003 (0.567, 1.775)	0.992

Table 4 (*continued*)

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Hypertension				
No				
Yes	0.941 (0.708, 1.243)	0.671		
Diabetes				
No				
Yes	1.179 (0.827, 1.662)	0.354		

P-values indicate the statistical significance of each variable's impact on a positive attitude in both univariate and multivariate analyses. *P* < 0.05 is considered statistically significant.

OR, Odds Ratio; CI, Confidence Interval; KAP, Knowledge, Attitude, and Practice; SEM, Structural Equation Modeling.

Table 5
Analysis of factors influencing positive practice.

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Knowledge	1.109 (1.085, 1.133)	< 0.001	1.089 (1.063, 1.116)	< 0.001
Attitude	1.025 (0.998, 1.053)	0.068	0.990 (0.958, 1.023)	0.551
Age, years				
< 35				
35–64	1.265 (0.715, 2.181)	0.406		
65–79	0.940 (0.529, 1.630)	0.829		
≥ 80	0.835 (0.393, 1.771)	0.638		
Sex				
Male				
Female	1.132 (0.885, 1.450)	0.325		
Marital status				
Single				
Married	0.900 (0.449, 1.708)	0.754		
Divorced/Widowed	0.825 (0.351, 1.896)	0.654		
Residence				
Rural				
Urban	1.378 (1.071, 1.775)	0.013	1.186 (0.868, 1.620)	0.284
Suburban	1.008 (0.668, 1.539)	0.969	0.856 (0.535, 1.369)	0.516
Education				
Primary school or below				
Middle school	1.493 (1.106, 2.019)	0.009	1.352 (0.957, 1.909)	0.087
High school/Technical secondary school	1.722 (1.225, 2.433)	0.002	1.406 (0.933, 2.119)	0.103
Junior college or above	1.786 (1.251, 2.568)	0.002	1.409 (0.899, 2.208)	0.135
Family members with healthcare professionals				
Yes				
No	1.610 (1.109, 2.384)	0.014	1.307 (0.856, 1.994)	0.215
Monthly per capita household income, yuan				
≤ 2000				
2001–5000	0.875 (0.636, 1.197)	0.405		
5001–10,000	1.193 (0.833, 1.709)	0.335		
10,001–20,000	1.100 (0.638, 1.940)	0.737		
> 20,000	0.996 (0.573, 1.768)	0.989		
Type of health insurance				
Social health insurance only				
Commercial health insurance	0.632 (0.166, 2.565)	0.495	0.377 (0.085, 1.665)	0.198
Both social and commercial health insurance	1.811 (0.974, 3.629)	0.074	0.995 (0.480, 2.064)	0.990
No insurance	2.022 (1.070, 4.159)	0.040	2.556 (1.244, 5.255)	0.011
Duration since gastrointestinal tumor diagnosis				
< 6 months				
6–12 months	1.193 (0.865, 1.654)	0.285	1.073 (0.751, 1.534)	0.698
1–2 years	0.922 (0.655, 1.304)	0.645	0.898 (0.611, 1.322)	0.586
2–3 years	0.687 (0.454, 1.045)	0.077	0.529 (0.332, 0.844)	0.008
≥ 3 years	0.745 (0.511, 1.093)	0.130	0.626 (0.408, 0.961)	0.032
Type of gastrointestinal tumor diagnosed				
Oesophageal tumor				
Gastric tumor	1.261 (0.856, 1.855)	0.240		
Hepatic tumor	0.773 (0.436, 1.384)	0.380		
Pancreatic tumor	0.984 (0.548, 1.801)	0.956		
Colon tumor	1.350 (0.899, 2.032)	0.149		
Rectal tumor	0.913 (0.627, 1.326)	0.635		
Other	0.931 (0.534, 1.647)	0.804		
Family history of tumors				
Yes				
No	0.870 (0.646, 1.177)	0.362		
Doubts about nutritional management				
Yes, many doubts				
Yes, some doubts	1.180 (0.830, 1.671)	0.354	1.014 (0.687, 1.497)	0.944

Table 5 (*continued*)

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P	OR (95% CI)	P
No doubts	2.199 (1.520, 3.177)	< 0.001	1.539 (1.015, 2.334)	0.042
Nutritional screening				
Yes				
No	5.711 (4.009, 8.355)	< 0.001	4.288 (2.921, 6.295)	< 0.001
Primary caregiver				
Spouse				
Parents	1.501 (0.903, 2.598)	0.130	1.301 (0.736, 2.297)	0.365
Children	1.013 (0.768, 1.343)	0.926	1.010 (0.731, 1.397)	0.950
Other	0.556 (0.348, 0.893)	0.015	0.492 (0.291, 0.832)	0.008
Stoma				
Yes				
No	0.911 (0.673, 1.240)	0.548		
Currently using a nutrition tube				
Yes				
No	1.361 (0.798, 2.424)	0.275		
Hypertension				
No				
Yes	0.974 (0.747, 1.265)	0.844		
Diabetes				
No				
Yes	0.946 (0.670, 1.322)	0.748		

P-values in the table indicate the statistical significance of each variable's association with positive practice in both univariate and multivariate analyses. *P* < 0.05 is considered statistically significant.

OR, Odds Ratio; CI, Confidence Interval; KAP, Knowledge, Attitude, and Practice; SEM, Structural Equation Modeling.

addressing patient uncertainties through targeted educational interventions. These findings reinforce the need for clear communication and educational support to reduce skepticism and promote adherence to recommended nutritional practices. Addressing these doubts through patient education and clear communication may therefore improve both attitudes and practices.

In older population, the influence of residential area and health insurance on nutritional management knowledge presents different interplay. While urban residence generally offers better access to healthcare resources, this advantage appears diminished in older adults, likely due to factors such as reduced mobility and the uniformity of information sources, which level the playing field across different living environments. Similarly, the benefits of comprehensive health insurance are less pronounced in this age group, potentially due to universal coverage provided by governmental health programs, which minimizes the additional benefits of private insurance.[30,31]

Moreover, in the knowledge dimension, a significant portion of respondents are not familiar with critical guidelines and implications of nutrition in cancer treatment, such as the "Dietary Guidelines for Chinese Residents (2022)." Similarly, in the attitudes dimension, there are
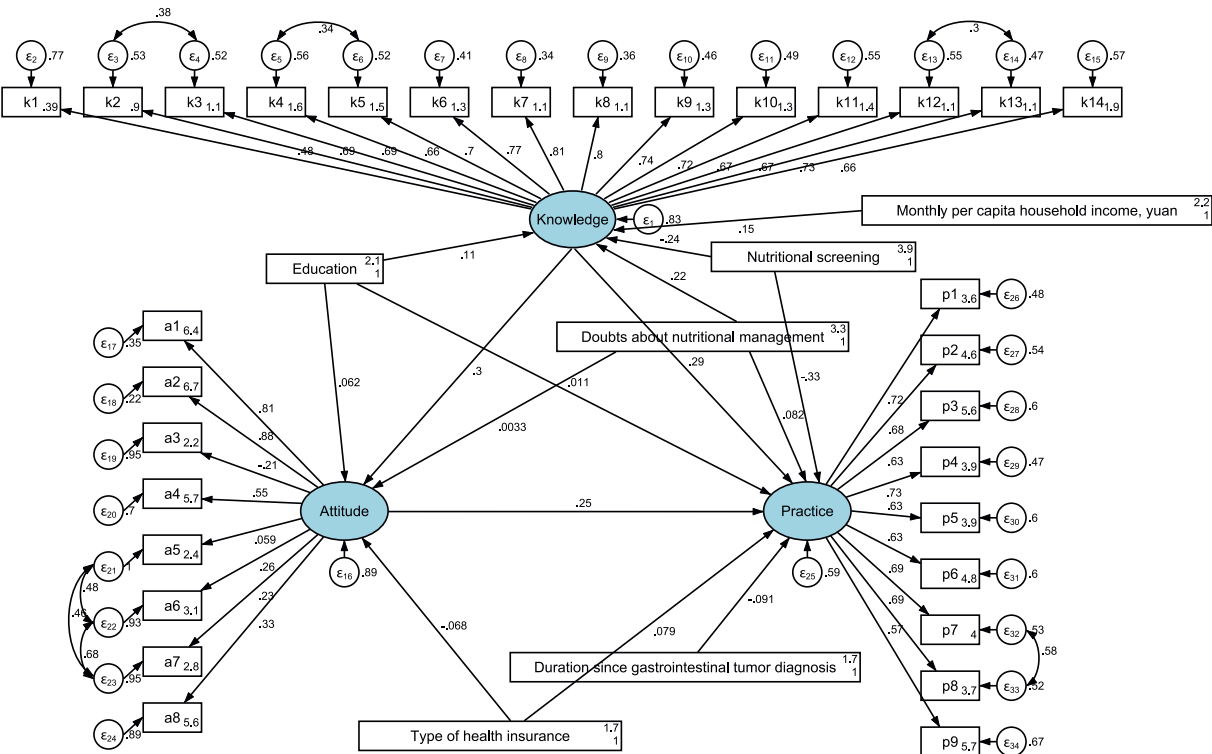

Fig. 1. SEM for KAP. SEM, Structural Equation Modeling; KAP, Knowledge, Attitude, and Practice.

concerning levels of neutrality and disagreement on crucial nutritional beliefs, such as the effectiveness of dietary adjustments on tumor progression. In practices, a substantial number of patients are not adhering to recommended nutritional screenings and consultations, which are vital for effective management of their condition. These findings underscore the need for more in-depth educational strategies that target both healthcare professionals and patients. Effective knowledge dissemination can enhance understanding of the importance of nutrition in cancer care, addressing gaps such as unfamiliarity with guidelines and misconceptions about the role of diet in disease progression. To address these gaps, targeted and specific interventions are necessary. For instance, increasing awareness of the "Dietary Guidelines for Chinese Residents (2022)" through structured educational campaigns could be highly impactful. Tailored educational initiatives that address specific knowledge gaps identified in the survey, such as the importance of following dietary guidelines and understanding the nutritional implications of cancer treatments, are essential for improving patient adherence. Programs could include workshops or online courses that are accessible to patients of varying ages and educational backgrounds, supported by literature suggesting that tailored education improves patient outcomes.[32,33] Incorporating these into routine care protocols could improve the standard of nutritional management among gastrointestinal cancer patients. Offering personalized nutritional counseling sessions that account for each patient's specific health status, treatment stage, and personal dietary preferences can be highly beneficial. This approach is supported by research demonstrating the effectiveness of counseling in enhancing nutritional practices.[34,35] Moreover, expanding access to nutritional counseling services within oncology clinics ensures that patients receive guidance tailored to their specific needs, which can positively affect both treatment tolerance and overall quality of life. Additionally, advocating for policies that mandate nutritional assessments as an integral component of cancer care protocols ensures that all patients receive baseline nutritional screenings and necessary follow-ups.[36]

Implications for nursing practice and research

The findings of this study suggest a need for integrating structured nutritional education and counseling into routine oncology nursing. The knowledge gaps identified, particularly regarding key guidelines such as the "Dietary Guidelines for Chinese Residents (2022)" and the role of nutrition in cancer treatment, indicate areas where targeted interventions may be beneficial. Addressing specific misconceptions—such as the belief that weight loss alone signals malnutrition or that skipping meals could impact tumor cells—could improve patient adherence to nutritional guidelines. The low rates of regular nutritional screening and professional consultation further highlight the importance of ensuring healthcare providers routinely assess and discuss nutritional management with patients. Nurses should provide patient-centered nutritional education, integrate screening and counseling into routine care, and advocate for personalized dietary plans tailored to patients' needs. Collaboration with dietitians and oncologists can enhance multidisciplinary care. Future research should evaluate nurse-led interventions, assess the impact of counseling on patient outcomes, and explore barriers to long-term adherence. Comparative studies across urban and rural settings can address disparities, while digital health tools like mobile apps or telehealth platforms may improve engagement and adherence, ultimately enhancing care for gastrointestinal cancer patients. Future research could focus on longitudinal studies to examine how improved nutritional knowledge impacts patient outcomes and treatment tolerance over time.

Limitations

This study has several limitations that warrant consideration. First, its cross-sectional design restricts the ability to infer causality between the observed knowledge, attitudes, and practices and the outcomes in nutritional management among patients. Second, the sample is geographically limited to hospitals in Jiangsu, Henan, Shanghai, and Tianjin, which may not fully represent the diverse demographic and socioeconomic backgrounds of gastrointestinal cancer patients across China. Besides, the study utilized a self-developed nutritional management assessment scale that has not been validated against a standardized tool. This absence of a benchmark may affect the credibility and generalizability of the results. Moreover, the absence of tumor staging and anxiety or depression assessments may overlook important factors influencing participants' KAP. Lastly, the reliance on self-reported data may introduce response bias, as participants might have provided socially desirable answers or may not have accurately recalled their dietary habits and nutritional management practices.

Conclusions

In conclusion, this study reveals that patients with gastrointestinal cancer exhibit significant gaps in knowledge, generally positive attitudes, and suboptimal practices regarding nutritional management. These findings highlight the urgent need for targeted educational programs tailored to enhance patient knowledge and actively promote beneficial nutritional practices. Hospitals and healthcare providers should prioritize the integration of comprehensive nutritional education and support services within oncology care protocols, particularly for those with lower educational and income levels, to improve patient outcomes.

CRediT authorship contribution statement

Xiaoxu Zhi: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing - Original draft, Writing - Review & Editing. **Qin Xu**: Conceptualization, Methodology, Formal analysis, Writing - Review & Editing. **Jun Yao**: Conceptualization, Methodology, Formal analysis, Writing - Review & Editing. **Liuliu Zhang**: Resources, Supervision, Project administration. **Yun Zhao**: Resources, Supervision, Project administration. **Liu Yang**: Resources, Investigation, Supervision. **Sheng Li**: Investigation, Resources. **Funa Yang**: Investigation, Resources, Data curation. **Zhie Gu**: Investigation, Resources, Data curation. **Xiaoju Zhang**: Investigation, Resources. **Huizi Tian**: Investigation, Resources. **Jie Chen**: Data curation, Formal analysis, Writing - Review & Editing. **Min Wang**: Data curation, Investigation. **Zhiyan Zhou**: Data curation, Investigation. All authors have read and approved the final manuscript.

Ethics statement

This study was approved by the Ethic Committee of Jiangsu Cancer Hospital (Approval No. 2022KE-KUAI058) and was conducted in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. All participants provided written informed consent.

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Funding

Foundation of China, China (Grant No. 82073407) and Jiangsu Provincial Research Project on Elderly Health (Grant No. LKM2022013). The funders had no role in considering the study design or in the collection, analysis, interpretation of data, writing of the report, or decision to submit the article for publication.

Declaration of competing interest

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apjon.2025.100688.

References

1. Garutti M, Noto C, Pastò B, et al. Nutritional management of oncological symptoms: a comprehensive review. *Nutrients*. 2023;15(24). https://doi.org/10.3390/nu15245068.
2. Cencioni C, Trestini I, Piro G, et al. Gastrointestinal cancer patient nutritional management: from specific needs to novel epigenetic dietary approaches. *Nutrients*. 2022;14(8). https://doi.org/10.3390/nu14081542.
3. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2021;71(3):209–249. https://doi.org/10.3322/caac.21660.
4. Guggenheim DE, Shah MA. Gastric cancer epidemiology and risk factors. *J Surg Oncol*. 2013;107(3):230–236. https://doi.org/10.1002/jso.23262.
5. Karimi P, Islami F, Anandasabapathy S, Freedman ND, Kamangar F. Gastric cancer: descriptive epidemiology, risk factors, screening, and prevention. *Cancer Epidemiol Biomarkers Prev*. 2014;23(5):700–713. https://doi.org/10.1158/1055-9965.Epi-13-1057.
6. Sitarz R, Skierucha M, Mielko J, Offerhaus GJA, Maciejewski R, Polkowski WP. Gastric cancer: epidemiology, prevention, classification, and treatment. *Cancer Manag Res*. 2018;10:239–248. https://doi.org/10.2147/cmar.S149619.
7. Dekker E, Tanis PJ, Vleugels JLA, Kasi PM, Wallace MB. *Colorectal cancer. Lancet*. 2019;394(10207):1467–1480. https://doi.org/10.1016/s0140-6736(19)32319-0.
8. Deane AM, Chapman MJ, Reintam Blaser A, McClave SA, Emmanuel A. Pathophysiology and treatment of gastrointestinal motility disorders in the acutely Ill. *Nutr Clin Pract*. 2019;34(1):23–36. https://doi.org/10.1002/ncp.10199.
9. Petrillo A, Pompella L, Tirino G, et al. Perioperative treatment in resectable gastric cancer: current perspectives and future directions. *Cancers*. 2019;11(3). https://doi.org/10.3390/cancers11030399.
10. Blackwood HA, Hall CC, Balstad TR, et al. A systematic review examining nutrition support interventions in patients with incurable cancer. *Support Care Cancer*. 2020;28(4):1877–1889. https://doi.org/10.1007/s00520-019-04999-4.
11. Doménech Briz V, Gea-Caballero V, Chover-Sierra E, et al. Knowledge level of ICU nurses regarding nutritional assessment of critically Ill patients: a systematic review. *Nurs Rep*. 2024;14(1):586–602. https://doi.org/10.3390/nursrep14010045.
12. Chowdhury CR, Dey Chowdhury A, Shahnawaz K, Markus AF. Level of oral cancer awareness among Indian rural population: a possible research model using knowledge, attitude and practice (KAP) intervention and its utilisation in low resource settings of LMICs. *J Oral Biol Craniofac Res*. 2022;12(1):154–160. https://doi.org/10.1016/j.jobcr.2021.10.008.
13. Tang H, Wang R, Yan P, et al. Dietary behavior and its association with nutrition literacy and dietary attitude among breast cancer patients treated with chemotherapy: a multicenter survey of hospitals in China. *Patient Prefer Adherence*. 2023;17:1407–1419. https://doi.org/10.2147/ppa.S413542.
14. Mosli M, Alnahdi Y, Alghamdi A, et al. Knowledge, attitude, and practices of primary health care physicians toward colorectal cancer screening. *Saudi J Gastroenterol*. 2017;23(6):330–336. https://doi.org/10.4103/sjg.SJG_1_17.
15. Xu P, Li D, Li J, Zhang C. Knowledge, attitude, and practice towards enhanced recovery after surgery among colorectal cancer patients. *Sci Rep*. 2024;14(1):9034. https://doi.org/10.1038/s41598-024-59361-4.
16. Zhang H, Zhao C, Song C, Wu Y, Wei D, Li X. Knowledge, attitude, and practice of healthcare workers on early gastrointestinal cancer in China. *Front Public Health*. 2023;11:1191699. https://doi.org/10.3389/fpubh.2023.1191699.
17. Deftereos I, Kiss N, Isenring E, Carter VM, Yeung JM. A systematic review of the effect of preoperative nutrition support on nutritional status and treatment outcomes in upper gastrointestinal cancer resection. *Eur J Surg Oncol*. 2020;46(8):1423–1434. https://doi.org/10.1016/j.ejso.2020.04.008.
18. Viana E, Oliveira IDS, Rechinelli AB, et al. Malnutrition and nutrition impact symptoms (NIS) in surgical patients with cancer. *PLoS One*. 2020;15(12):e0241305. https://doi.org/10.1371/journal.pone.0241305.
19. Szawłowski AW, Gromadzka-Ostrowska J, Paluszkiewicz P, Słodkowski M, Sobocki J. *Żywienie W Chorobach Nowotworowych*. Wydawnictwo Lekarskie PZWL; 2020.
20. Beeken RJ, Williams K, Wardle J, Croker H. "What about diet?" A qualitative study of cancer survivors' views on diet and cancer and their sources of information. *Eur J Cancer Care*. 2016;25(5):774–783. https://doi.org/10.1111/ecc.12529.
21. Lee F, Suryohusodo AA. Knowledge, attitude, and practice assessment toward COVID-19 among communities in East Nusa Tenggara, Indonesia: a cross-sectional study. *Front Public Health*. 2022;10:957630. https://doi.org/10.3389/fpubh.2022.957630.
22. Chen Q, Zhang Y, Li H. Knowledge, attitude, and practice toward non-nutritive sweeteners among the population with reduced sugar intake requirement. *Front Nutr*. 2023;10:1268599. https://doi.org/10.3389/fnut.2023.1268599.
23. Di Santo SG, Colombo M, Silvaggi M, et al. The sexual and parenting rights of people with physical and psychical disabilities: attitudes of Italians and socio-demographic factors involved in recognition and denial. *Int J Environ Res Publ Health*. 2022;19(2). https://doi.org/10.3390/ijerph19021017.
24. Yuan H, Chen S, Pan G, Zheng L. Social pension scheme and health inequality: evidence from China's new rural social pension scheme. *Front Public Health*. 2021;9:837431. https://doi.org/10.3389/fpubh.2021.837431.
25. Zhan X, Liu J, Long H, et al. An intelligent auxiliary framework for bone malignant tumor lesion segmentation in medical image analysis. *Diagnostics*. 2023;13(2). https://doi.org/10.3390/diagnostics13020223.
26. Zhao M, Liu Y, Gyilbag A. Assessment of meteorological variables and air pollution affecting COVID-19 cases in urban agglomerations: evidence from China. *Int J Environ Res Publ Health*. 2022;19(1). https://doi.org/10.3390/ijerph19010531.
27. Chaparro-Narváez P, Ordóñez-Monak IA, Trujillo N, Castañeda-Orjuela CA, Arroyave I. Educational inequalities in heart failure mortality and the cycles of the internal armed conflict in Colombia: an observational panel study of ecological data, 1999-2017. *Heliyon*. 2023;9(2):e13050. https://doi.org/10.1016/j.heliyon.2023.e13050.
28. Pian W, Lin L, Li B, Qin C, Lin H. How users make judgements about the quality of online health information: a cross-sectional survey study. *BMC Public Health*. 2022;22(1):2001. https://doi.org/10.1186/s12889-022-14418-9.
29. Seo S, Kwon YD, Yoo KB, Lee Y, Noh JW. Is transient and persistent poverty harmful to multimorbidity?: model testing algorithms. *Int J Environ Res Publ Health*. 2019;16(13). https://doi.org/10.3390/ijerph16132395.
30. Xu R, Li S, Mu T, Xie X, Xu C, Lv X. Substantial increase in accessibility to essential anticancer medicines in Anhui, China: a longitudinal study. *Inquiry*. 2023;60:469580231151783. https://doi.org/10.1177/00469580231151783.
31. Zeng Y, Luo J, Ou L, et al. The impact of medical insurance on medical expenses for older Chinese: evidence from the national baseline survey of CLHLS. *Medicine (Baltim)*. 2019;98(39):e17302. https://doi.org/10.1097/md.0000000000017302.
32. Makhinova T, Barner JC, Brown CM, Richards KM, Rascati KL, Nag A. Improving asthma management: patient-pharmacist partnership program in enhancing Therapy adherence. *Pharmacy (Basel)*. 2022;10(1). https://doi.org/10.3390/pharmacy10010034.
33. McQueen DB, Warren CM, Xiao AH, Shulman LP, Jain T. Disparities among infertility patients regarding genetic carrier screening, sex selection, and gene editing. *J Assist Reprod Genet*. 2021;38(9):2319–2325. https://doi.org/10.1007/s10815-021-02261-7.
34. Gonzalez DE, McAllister MJ, Waldman HS, et al. International society of sports nutrition position stand: tactical athlete nutrition. *J Int Soc Sports Nutr*. 2022;19(1):267–315. https://doi.org/10.1080/15502783.2022.2086017.
35. McNamara K, Wood E. Food taboos, health beliefs, and gender: understanding household food choice and nutrition in rural Tajikistan. *J Health Popul Nutr*. 2019;38(1):17. https://doi.org/10.1186/s41043-019-0170-8.
36. Cederholm T, Jensen GL, Correia M, et al. GLIM criteria for the diagnosis of malnutrition - a consensus report from the global clinical nutrition community. *Clin Nutr*. 2019;38(1):1–9. https://doi.org/10.1016/j.clnu.2018.08.002.